

Application No.: 10/572,588
Art Unit 1797

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Reply to Office Action dated November 27, 2009
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AMENDMENTS TO THE CLAIMS

1. (Currently Amended) An external pressure type hollow fiber membrane module comprising:

a hollow fiber membrane bundle formed of a plurality of hollow fiber membranes,

a cylindrical housing, and

a nozzle for allowing a fluid to enter into and exit from the housing,

the hollow fiber membranes being fixedly adhered to each other and to the inner wall of the housing at ends of the hollow fiber membrane bundle;

a hollow part opened in one side or both sides of adheringly-fixed ends of the hollow fiber membrane; and

wherein the nozzle for allowing the fluid to enter and exit therefrom is installed on a side face of the housing of at least one ~~adhesively fixed~~ adheringly fixed end at which the hollow part is opened;

wherein the membrane bundle has a cross-sectional area coincident with the cross-sectional area of the cylindrical housing and a ratio PB/PA of membrane-occupying rates is 0.50 or more but 0.95 or less when PA is defined as the membrane-occupying rate in a neighboring region (A) having a cross-sectional area that extends substantially symmetrically about a line coincident with the longitudinal axis of the nozzle and substantially bisecting the cylindrical housing and extends from a side of the cylindrical housing adjacent to the nozzle a substantial distance ~~from adjacent to the nozzle and~~ toward the center of the cylinder, and PB is defined as the membrane-occupying rate in a non-neighboring region (B) of the nozzle which has a cross-sectional area that extends ~~between~~ from the neighboring region (A) and up to a side face of the

cylinder opposite to the side face of the cylinder where the nozzle is located among a membrane chargeable region in the inner side of an ~~adhesively~~ adheringly-fixed part, in at least one ~~adhesively fixed~~ adheringly fixed end of the opened hollow part in the vicinity of the nozzle, and wherein the membrane occupying rate decreases along said coincident line from the nozzle to a side of the cylindrical housing opposite the nozzle.

2. (Currently Amended) An external pressure type hollow fiber membrane module comprising: a hollow fiber cartridge having a hollow fiber membrane bundle formed of a plurality of

hollow fiber membranes, of which both end parts are ~~adhesively~~ adheringly fixed and hollow parts in at least one end of ~~adhesively~~ adheringly-fixed ends are opened; and

a cylindrical housing accommodating the cartridge and having a nozzle for allowing a fluid to enter and exit therefrom installed on at least one side face, in which the nozzle installed is fixed so as to be placed in the vicinity of the inner surface of an ~~adhesively~~ adheringly-fixed part in the opened hollow parts side in the hollow fiber membrane cartridge;

wherein the membrane bundle has a cross-sectional area coincident with the cross-sectional area of the cylindrical housing and a ratio PB/PA of membrane-occupying rates is 0.50 or more but 0.95 or less when PA is defined as the membrane-occupying rate in a neighboring region (A) having a cross-sectional area that extends substantially symmetrically about a line coincident with the longitudinal axis and substantially bisecting the cylindrical housing and extends from a side of the cylindrical housing adjacent to the nozzle a substantial distance from adjacent to the nozzle and toward the center of the cylinder, and PB is defined as the membrane-

occupying rate in a non-neighboring region (B) of the nozzle which has a cross-sectional area that extends ~~between~~ from the neighboring region (A) ~~and up to~~ a side face of the cylinder opposite to the side face of the cylinder where the nozzle is located among a membrane chargeable region in the inner side of the ~~adhesively~~ adheringly-fixed part, in an ~~adhesively~~ adheringly-fixed end in the vicinity of the nozzle, and

wherein the membrane occupying rate decreases along said coincident line from the nozzle to a side of the cylindrical housing opposite to the nozzle.

3. (Currently Amended) The external pressure type hollow fiber membrane module according to claim 1 or 2, wherein in the neighboring region (A) of the nozzle, among a membrane chargeable region in the inner side of an ~~adhesively~~ adheringly-fixed part, membrane occupying-rate PC is 0.5 times or more but 2.0 times or less with reference to membrane-occupying rate PA in the neighboring region (A), in every unit region (C) constituting the neighboring region (A).

4. (Currently Amended) The external pressure type hollow fiber membrane module according to claim 1 or 2, wherein PA, PB1 and PB2 of the membrane-occupying rates have the relation of $PA \geq PB1 \geq PB2$ and further PA is 0.40 or more but 0.60 or less and PB2 is 0.20 or more but less than 0.40 when each of PB1 and PB2 is defined as a membrane-occupying rate in a first non-neighboring region (B1) and a second non-neighboring region (B2) in the non-neighboring region (B) of the nozzle among the membrane chargeable region in the inner side of an ~~adhesively~~ adheringly-fixed part.

5. (Currently Amended) The external pressure type hollow fiber membrane module according to claim 1, wherein the non-neighboring region (B) of the nozzle among the membrane chargeable region in the inner side of an ~~adhesively~~ adheringly-fixed part includes at least one unit region in which membrane-occupying rate PC in unit region (C) constituting the non-neighboring region (B) is less than 0.5 times with reference to the membrane-occupying rate PB in the non-neighboring region (B).

6. (Original) The external pressure type hollow fiber membrane module according to claim 1 or 2, wherein a current plate is arranged in the vicinity of the nozzle of outer circumference parts of the hollow fiber membrane bundle.

7. (Original) The external pressure type hollow fiber membrane module according to claim 6, wherein the current plate is cylindrical, accommodates the hollow fiber membrane bundle inside of it, has a plurality of through-holes in a wall surface except the vicinity of the nozzle, and has no through-hole in the vicinity of the nozzle.

8. (Currently Amended) The external pressure type hollow fiber membrane module according to claim 1 or 2, wherein an adhesive bond part constituting the ~~adhesively~~ adheringly-fixed part is made of a single layer of a high polymer material, and has the hardness of 50A to 70D in a range of operating temperatures.

9. (Currently Amended) A method for manufacturing the external pressure type hollow fiber membrane module according to claim 1 or 2 including: previously inserting a plurality of columnar materials into an end of a hollow fiber membrane bundle at least in a side of making a hollow part opened; accommodating the hollow fiber membrane bundle which keeps the state of the insertion in a vessel for forming an ~~adhesively~~ adheringly-fixed part; injecting an adhesive bond into the vessel and curing it; then cutting an end face of the hollow fiber membrane bundle to form the ~~adhesively~~ adheringly-fixed part; and consequently making the columnar materials having a length of 0.3 to 0.9 times with reference to a thickness of the ~~adhesively~~ adheringly-fixed part exist at least in the ~~adhesively~~ adheringly-fixed part of a neighboring region (A).

10. (Currently Amended) A method for manufacturing the external pressure type hollow fiber membrane module according to claim 1 including: accommodating a hollow fiber membrane bundle in a housing case having a nozzle for allowing a fluid to enter and exit therefrom at least on one side face; horizontally rotating the housing case in a state of keeping the nozzle directing toward a lower direction than a horizontal direction; injecting an adhesive bond into the housing case under the centrifugal force; and curing it to form an ~~adhesively~~ adheringly-fixed part.

11. (Currently Amended) An external pressure type hollow fiber membrane module comprising:

a cylindrical housing;

a hollow fiber membrane bundle formed of a plurality of hollow fiber membranes located inside of the cylindrical housing;

a nozzle for allowing a fluid to enter into and exit from the housing, located on a side wall of the cylindrical housing

wherein the membrane bundle is separated in cross-section into two regions, a first region taking up at least one fourth of the cross-sectional area of the membrane bundle located between a portion of the wall of the cylinder that extends about the nozzle to approximately the center of the cylinder, and a second region that extends from the first region to the side of the wall of the cylinder that is opposite to the side of the wall in which the nozzle is located, and

wherein a ratio PB/PA of membrane-occupying rates is 0.50 or more but 0.95 or less when PA is defined as the membrane-occupying rate in the first region, and PB is defined as the membrane-occupying rate in the second region, and

wherein the membrane occupying rate decreases across the two regions from the nozzle to a side of the cylindrical housing opposite to the nozzle.

12. (New) An external pressure type hollow fiber membrane module comprising:

a rod-shaped bundle of hollow fiber membranes formed of a plurality of hollow fiber membranes,

a cylindrical housing, and

a nozzle for allowing a fluid to enter into and exit from the housing,

the hollow fiber membranes being fixedly adhered to each other and to the inner wall of the housing at ends of the hollow fiber membrane bundle;

a hollow part opened in one side or both sides of adheringly-fixed ends of the hollow fiber membrane; and

wherein the nozzle for allowing the fluid to enter and exit therefrom is installed on a side face of the housing of at least one adheringly fixed end at which the hollow part is opened;

wherein the rod-shaped bundle of hollow fiber membranes has a has a neighboring region (A) having a cross-sectional area that surrounds the nozzle and extends from the nozzle approximately half way to a side of the cylindrical housing opposite to the nozzle, and a non-neighboring region (B) of the nozzle which has a cross-sectional area that encompasses the cross-sectional area of the cylindrical housing other than that cross-sectional area encompassed by neighboring region (A), and

wherein the membrane occupying rate decreases along a line coincident with the longitudinal axis of the nozzle that substantially bisects the cylindrical housing from the nozzle to a side of the cylindrical housing opposite the nozzle.